DOCUMENT RESUME

ED 277 298 HE 019 887

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TITLE Predictors of Success of Black Americans in a College-Level Pre-Health Professions Program.
PUB DATE 86
NOTE 8p.
PUB TYPE Journal Articles (080) -- Reports - Research/Technical (143)
JOURNAL CIT Advisor; v6 n4 p5-11 Sum 1986

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS *Academic Achievement; *Academic Persistence; Black Colleges; *Black Students; Dentistry; *Health Occupations; Higher Education; Optometry; Osteopathy; Pharmacy; Podiatry; *Predictor Variables; *Premedical Students; Veterinary Medicine
IDENTIFIERS *Xavier University of Louisiana

ABSTRACT

Predictors of success for black freshmen entering Xavier University of Louisiana with an interest in the health professions were studied. Health professions were considered as the mainline fields of medicine, osteopathic medicine, dentistry, veterinary medicine, optometry, podiatry, and pharmacy. Students majoring in biology, chemistry, or pre-pharmacy (pre-health) who entered the predominantly-black institution in 1981, 1982, and 1983 were investigated. Success was defined as both persisting in pre-health and maintaining a grade point average sufficiently high to provide a reasonable chance of gaining admission into a health professions school. The following traditional variables were chosen for study: high school grade point average, composite score on the American College Testing Program and scores on its four subsections, scores on the three portions of the Nelson-Denny Reading Test in terms of grade-level equivalents, and sex of students. Complete data were available for 324 students (210 females and 114 males). Of this number 85 were successful by the defined criteria and 239 were not. Almost all the variables distinguished successful from unsuccessful students to some degree. Specific findings are reviewed, along with the question of whether the predictive power varied for black males and females. (SW)

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PREDICTORS OF SUCCESS OF BLACK AMERICANS IN A COLLEGE-LEVEL PRE-HEALTH PROFESSIONS PROGRAM

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College faculty in general, and those in biology and chemistry in particular, are well aware of the high attrition of students from pre-health professions programs and the relatively poor performance of many who persist in them. While such is to be expected considering the high level of scientific and technical knowledge needed to practice modern medicine, it is a major obstacle to efforts to increase the number of black Americans in the health professions. The latter is of particular concern because the present underrepresentation of blacks in medicine and related fields results in lower quality and less availability of primary health care in black communities. It has been found(1) that "minority health providers, particularly physicians, are more likely to serve minority patients for a variety of reasons. Consequently the shortage of minority health practitioners has a direct negative effect on minority communities." The magnitude of the problem is illustrated by noting that although the census currently estimates the percentage of blacks in the nation's populace to be approximately 12 percent(2), less than 2.5 percent of the nation's health professionals are black(3). There is thus an urgent need to increase the number of blacks succeeding in pre-health professions programs as one step in the process of improving the health care provided black America.

If there is to be significant progress toward reaching the goal of increasing the number of black Americans in health fields, both predominantly black and majority institutions must be involved in the effort. The potential role of the predominantly black colleges is indicated by the fact that, while they enrolled only 17 percent of black Americans in college in the late 1970s, they awarded 37 percent of the baccalaureate degrees received by blacks nationwide and more than 50 percent of such degrees in states where the traditionally black colleges are located(4). Studies of factors which affect achievement of blacks in pre-health professions programs are of direct value in the effort to increase the number of blacks obtaining careers in the health professions. This paper describes one such study, an effort to identify predictors of success of black Americans interested in the health professions at Xavier University of Louisiana, a small predominantly black institution in New Orleans.

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Overview

Xavier University of Louisiana (XU) is a Catholic, liberal arts institution requiring 56 semester hours of history, art, philosophy, etc., for graduation. Although a typical liberal arts institution in philosophy, Xavier does not have the enrollment pattern of the typical liberal arts institution. At present approximately 50 percent of the 1,600 (or so) full-time undergraduates at Xavier are in majors designed to lead into a health profession. The university places from 65 to 75 blacks into health professions schools yearly, is regularly number one in the United States in placing black Americans into colleges of pharmacy, and is consistently one of the top five schools in the nation in placing blacks into medical school. Xavier is thus particularly appropriate for studies of blacks interested in the health professions.

The data most readily available for study as predictors of success at the college-level, and thus of most value if they predict, are the traditional variables used in evaluating application to college. These are high school grade point average and scores on the SAT or ACT. Previous investigations have considered two measures of success of blacks in college — performance, as measured by grades, and persistence, usually measured by graduation. Attempts to predict the performance of blacks at the undergraduate level have yielded conflicting results. Some(5,6,7) have indicated that traditional variables predict overall college grades of black students at predominantly black colleges reasonably well, and at least one found that there was a significant relationship between scores on the Nelson-Denny Reading Test and grades of black freshmen college students(8). Others determined that traditional criteria predicted the performance of black students at predominantly white institutions considerably less accurately than they predicted the performance of white students at those same institutions(9,10). There is also evidence that traditional

criteria are less useful in predicting the academic performance of black males than that of black females(11,12). Finally, at least two studies of persistence have shown that traditional variables were not effective in predicting graduation for either minority students at selective majority institutions(13) or low-income students(14).

Since none of the above specifically consider students in science majors, of potentially equal interest are recent studies of predictors of grade in general biology(15), general chemistry(16), precalculus and calculus I(17), and non-calculus physics(18) at Xavier. These studies indicated that combinations of ACT composite score and high school grade point average were good predictors of the grades of blacks interested in health professions in the first semester of freshman-level biology, chemistry, and mathematics ($R = 0.640$, 0.641, and 0.597, respectively). They were also of moderate use in predicting grades in the first term on noncalculus physics ($R = 0.490$), a course normally taken in the sophomore or junior year at XU.

These studies suggest a number of questions to consider in the present investigation.

1. Can traditional variables predict success of black Americans interested in the health professions at a traditionally black institution? If so, what is the predictive procedure?
2. How does predictive power for black males vary from that for black females?
3. What implications can be drawn from comparison of this study with past investigations?

Procedure

For the purposes of this study, "health professions" were defined as the mainline fields of medicine, osteopathic medicine, dentistry, veterinary medicine, optometry, podiatry, and pharmacy. Most professional schools offering degrees in these fields require a minimum number of credits in college-level mathematics and science. These normally include one year each of mathematics, biology with laboratory, general chemistry with laboratory, organic chemistry with laboratory, and physics with laboratory.

The population under study consisted of black Americans entering Xavier as freshmen and majoring in biology, chemistry, or pre-pharmacy (henceforth called "Pre-health") in the fall semesters of 1981, 1982, and 1983. The study was limited to this group because a) students interested in the health professions at XU almost always major in one of these three and, b) persons in all three majors take the basic set of courses required by health professions schools (see above). Although the economic status of individual students was not available, that of the group was probably below average, since more than 80 percent of XU's students qualify for federal financial aid.

Ten readily available, traditional variables were chosen for study as potential predictors of success. They were: high school grade point average (GPA) on a 4.0 scale; composite score on the American College Testing program (ACT) and scores on the four subsections (mathematics, English, natural science, and social science) on the established 1 to 36 scale; scores on the three portions of the Nelson-Denny Reading Test (vocabulary, comprehension, and total) in terms of grade level equivalents; and sex of student. An eleventh variable specifically related to Xavier, participation in a summer program (SOAR) designed to improve problem solving ability, was also included. This program has been described previously(19,20,21).

The purpose of this study was to determine which combination, if any, of the independent variables would best predict success in XU's pre-health program. Success in this context involves both persisting in pre-health and maintaining a grade point average sufficiently high to provide a reasonable chance of gaining admission into a health professions school. Although good grades alone will not guarantee admission into a health profession school, poor ones will certainly preclude it. While the minimum grade point which would assure a reasonable chance of admission is not clearly defined, and undoubtedly varies depending on the health field considered, past experience has shown that students with a grade point average lower than 2.5 are seldom admitted. Therefore, for this study, success was defined as maintaining continuous enrollment at Xavier during the freshman and sophomore years and returning for the junior year with a cumulative grade point average of 2.5 or better. "Nonsuccess" was correspondingly defined to be either having a grade point average lower than 2.5 at the beginning of the junior year *or* dropping out of pre-health by transferring to a major other than biology, chemistry, or pre-pharmacy or leaving the university before reaching this level. Combining dropouts and students with low grade point averages seemed reasonable since long experience had shown that dropping out of pre-health at Xavier, whether from the university or to another major, was almost invariably associated with poor academic performance. The beginning of the junior year was selected as the time to sample grade point average because the curricula of the three majors in pre-health are very similar up to this point; afterwards they begin to differ significantly. This raises questions as to whether or not later grade point averages are comparable. Grade point average at the beginning of the junior year also seemed to be particularly appropriate because the majority of students in pre-health at XU complete the basic set of mathematics and science courses generally required by health professions schools (see previous list) by this time. In addition, attrition of students with grade point averages of 2.5 or higher from these majors after the beginning of the junior year was generally low, less than two percent, supporting the contention that the classification scheme chosen is adequate.

Complete data were available for 324 students (210 females and 114 males), approximately 60 percent of those entering XU in pre-health in those years. Of the original 324, 85 (63 females and 22 males) were successful by the defined criteria and 239 (147 females and 92 males) were not.

Results

Analyses were performed using the Statistical Package for the Social Sciences (SPSS) — Version 9. Means and standard deviations were obtained for all variables for the 85 who were successful, the 239 who were not, and the total of 324. Dummy variables were introduced for sex (male = 1 and female = 0) and participation in SOAR (yes = 1 and no = 0). Results are summarized in Table 1. Grade point averages are reported on a 4.0 scale.

While the numerical values are generally self-explanatory, some observations might be made. The 16.2 mean of the ACT Composite scores for the total group was below the 17+ mean of freshman in the Southwest and South/Southeast (American College Testing Service, 1983) and reading scores of the total group were slightly below the expected 13th grade level. The value of 0.35 for the mean for sex for the total group reflected the fact that approximately two-thirds of the sample populace was female, a distribution by sex that is typical of the enrollment at the University as a whole. The lower mean for sex for successful students indicates that females were more likely to be successful than were males. The markedly higher mean for the SOAR variable for successful students indicated that SOAR participants were more likely to succeed than were non-SOAR students. Finally, as would be expected, the 85 who were successful in prehealth at Xavier had considerably higher averages on the academic variables than did the 239 who dropped out.

The statistical procedure selected for treating the data was multiple discriminant analysis. In this type of analysis, the linear combination of the predictor variables, if any, which best predicts whether or not a student will be successful is sought. First, it was necessary to determine whether the variables could be used to differentiate between the two groups in a statistically significant manner. Therefore, Wilks' lambda statistics, *F* ratios, and the probability of the relationship occurring by chance (p) were calculated for each of the potential predictor variables. These statistics are summarized in Table 2.

TABLE 1
Means and Standard Deviations of Potential Predictor Variables for Successful and Unsuccessful Prehealth Students

Variable	Successful (N = 85)		Unsuccessful (N = 239)		Total (N = 324)	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
High School GPA	3.30	0.51	2.64	0.53	2.81	0.60
ACT Composite	20.7	4.4	14.6	4.1	16.2	4.9
ACT English	19.6	6.1	13.0	6.0	14.7	6.7
ACT Mathematics	21.1	4.0	15.0	4.4	16.7	5.1
ACT Natural Science	22.6	5.1	16.8	4.9	18.3	5.5
ACT Social Science	19.0	6.3	13.0	5.8	14.6	6.5
Nelson-Denny Vocabulary	14.2	1.9	11.6	2.6	12.3	2.7
Nelson-Denny Comprehension	14.2	1.8	12.1	2.8	12.7	2.7
Nelson-Denny Total	14.3	1.8	11.9	2.4	12.5	2.5
Sex (Female = 0, Male = 1)	0.26	*	0.38	*	0.35	*
SOAR (Yes = 1, No = 0)	0.66	*	0.32	*	0.41	*

* These standard deviations are not reported because the variables only have values of 0 or 1.

TABLE 2
Statistics Regarding the Potential of the Predictor Variables for Predicting Success in Prehealth ($df = 1,32$)

Variable	Wilks' Lambda	F	p
High School GPA	0.767	97.6	<0.001
ACT Composite	0.705	134.6	<0.001
ACT English	0.804	78.6	<0.001
ACT Mathematics	0.715	128.1	<0.001
ACT Natural Science	0.785	88.0	<0.001
ACT Social Science	0.834	63.9	<0.001
Nelson-Denny Vocabulary	0.841	73.8	<0.001
Nelson-Denny Comprehension	0.884	42.4	<0.001
Nelson-Denny Total	0.821	70.0	<0.001
Sex (Female = 0, Male = 1)	0.986	4.4	0.037
SOAR (Yes = 1, No = 0)	0.907	33.1	<0.001

The Wilks' lambda statistic is an inverse measure of the discriminating power of the variable. The smaller the value, the better the variable distinguishes between successful and unsuccessful students. The ACT Composite was the single best variable for distinguishing between the two, with the ACT Mathematics score only slightly less accurate. However, the *F* ratios and corresponding probabilities (p) indicated that all of the variables except sex had some ability to differentiate successful and unsuccessful students at the 0.001 level.

Other calculations also indicated that the components of the ACT and the Nelson-Denny Reading Test were so highly correlated with their respective composites that statistical techniques might not work if both were included in the same study. Therefore, further analysis was separated into two parts, one using composites and the other components with the remaining variables.

In order to determine if combinations of the variables would improve ability to distinguish between successful and unsuccessful students, multiple discriminant analyses were then completed. A stepwise procedure was chosen in which variables were added one at a time so as to obtain the maximum increase in ability to discriminate at each step until adding more terms failed to produce a statistically significant improvement. Further, because of the strictly local relevance of SOAR, analyses were completed both with and without SOAR. Finally, analyses with composites were run for females and males separately. Table 3 summarizes the results of these analyses. All of the linear combinations were statistically significant at the 0.001 level.

These analyses indicated that a variety of combinations of the variables predicted success better than any single individual variable. In the analysis with composites (the first two in Table 3, ACT Composite and high school grade point average form the best combination for distinguishing the two if SOAR is omitted. Neither sex nor the Nelson-Denny Reading Total score entered into the equation;

TABLE 3
Summary of Multiple Discriminant Analyses for Successful and Unsuccessful Pre-health Students

Group	Predictor Variables in Analysis	Predictor Variables Added in Order	Standardized Discriminant Function Coefficients	Wilks' Lambda	F & d.f.	% Classified Correctly		
						Total	Suc.	Unsuc.
M+F	Composites	ACT Comp	0.663	0.618	65.8	82.3	68.1	88.0
N=323	with	HS GPA	0.529		&			
S*=85	SOAR	SOAR	0.206		3,320			
U=239								
	Composites	ACT Comp	0.717	0.628	95.1	82.3	67.3	88.3
	without	HS GPA	0.557		&			
	SOAR				2,321			
M+F	Components	ACT Math	0.421	0.599	42.5	82.3	69.3	87.6
N=323	with	HS GPA	0.509		&			
S*=85	SOAR	ACT NatScn	0.223		5,318			
U=239		SOAR	0.188					
		ACT English	0.185					
	Components	ACT Math	0.415	0.605	41.5	83.3	62.8	90.8
	without	HS GPA	0.524		&			
	SOAR	ACT NatScn	0.194		5,318			
		ACT English	0.184					
		ND Vocab	0.130					
F	Composites	ACT Comp	0.701	0.618	42.5	81.0	71.1	85.7
N=210	with	HS GPA	0.468		&			
S*=63	SOAR	SOAR	0.160		3,206			
U=147								
M	Composites	ACT Comp	0.446	0.624	16.5	86.8	54.5	94.6
N=114	with	HS GPA	0.562		&			
S*=22	SOAR	SOAR	0.286		4,109			
U=92		ND Total	0.277					

*S = Number of Successful Students, U = Number of Unsuccessful Students

therefore, neither improved prediction in a statistically significant manner. If SOAR is included as a possible predictor variable, it enters the equation at the third step, improving prediction slightly (Wilks' lambda dropped from 0.628 to 0.618). The standardized discriminant function coefficients (SDFC) represent the relative contribution of the corresponding variable to the function which discriminates between the two groups. The ACT Composite had the largest influence on prediction of success in both analyses (i.e., had the largest SDFC) and high school grade point average was next in importance. SOAR, although statistically significant, had considerably less weight in the equation than either of the first two.

Comparison of predicted and actual group membership for the group is presented in the last three columns of the table. These indicate that the two functions derived from composites predicted success equally well. Both correctly classified 82.3 percent of the cases — about 88 percent of the students who were unsuccessful and roughly 67.5 percent of those who were successful.

Similar calculations with components yielded similar results, as seen in the third and fourth analyses in Table 3. Combinations of ACT Mathematics, high school grade point average, ACT Natural Science, ACT English, and either SOAR or Nelson-Denny Vocabulary score were roughly equivalent in ability to distinguish successful and unsuccessful students. In both, the SDFCs showed high school grade point average to have the greatest weight in the combination. It was followed by ACT Mathematics, ACT Natural Science, and either SOAR and ACT English or ACT English and Nelson-Denny Vocabulary. Both of the functions formed from components distinguished between the successful and unsuccessful students to roughly the same degree. That with SOAR correctly classified 82.3 percent of the cases and that without SOAR classified 83.3 percent correctly. These values are approximately equivalent to the percentages correctly classified by the functions with composites.

The separate analyses for females and males (the fifth and sixth entries in Table 3) were conducted because some previous investigations had indicated that traditional criteria were less useful in predicting the academic performance of black males than of black females(11,12). Only composites were used in these analyses because the functions for composites were simpler and the first four analyses in Table 3 had indicated that there was no advantage to using components. Although the relatively small numbers in the categories made the data somewhat susceptible to sampling error, it seemed appropriate to conclude that the approximately equivalent values for Wilks's lambda for best combinations indicated that it was possible to predict success for females and males to approximately the same extent. However, both the relative magnitude of the SDFCs and the number of variables entering into the predictive functions suggested that the predictive procedures for the two might not be the same. For females, ACT Composite had the highest SDFC in the combination and consequently had the greatest weight in the predictive equation. High school grade point average was next in importance and SOAR was last. The Nelson-Denny Reading Total did not enter into the equation. In contrast, high school grade point average had the largest effect in the equation distinguishing successful males from unsuccessful ones with ACT Composite second in importance, SOAR third, and Nelson-Denny Reading Total entering equation as a fourth factor. Further suggestion that prediction could be improved by using different predictive procedures for black males than for black females was provided by the considerable differences noted in the efficiency with which the two equations correctly classified the data. Although the equation for males was more efficient overall than that for females, it was considerably less accurate at predicting successful males than its counterpart for females was at predicting successful females. The equation for males predicted only 54.5 percent of those who were successful.

Discussion

The following conclusions were drawn regarding the questions under consideration.

1. **Can traditional variables predict success of black Americans interested in the health professions at a traditionally black institution? If so, what is the predictive procedure?**

The answer clearly seemed to be "yes," at least when success was defined to persisting in pre-health and entering the junior year with a grade point average of 2.5 or higher. Almost all of the variables under consideration had the ability to distinguish successful from unsuccessful students to some degree. Of more importance was the fact that the relatively simple linear combination of ACT Composite score and high school grade point average, either with or without SOAR, differentiated between successful and unsuccessful students rather well, classifying 82.3 percent of the cases correctly. That these two had value in predicting success as defined in this study was not surprising. Previous studies had indicated that they were the best two-variable predictors of first semester grades in entry-level courses in biology, chemistry, mathematics, and physics at Xavier(15,16,17,18). Further, the combination of ACT Composite score and high school grade point average were good predictors of grades in those courses as indicated by multiple correlation coefficients with grades of 0.630, 0.625, 0.597, and 0.490, respectively.

Previous investigations at Xavier had produced conflicting results concerning the relationships between participation in SOAR and success. On one hand, studies of attrition indicate that SOAR students were almost twice as likely to complete degree requirements in biology or chemistry as were non-SOAR students entering XU in the same year in the same majors. On the other hand, the "SOAR" variable appeared in only one of the stepwise multiple regression equations for predicting grade in the four entry-level courses, that for physics. The present study seems to confirm the prior indication that participa-

tion in SOAR has a larger effect on persistence in pre-health at Xavier than on grades.

It should be noted that these conclusions are in disagreement with those(13,14) which indicated that traditional variables did not predict persistence in college of either minority or low-income students (many of whom were from minority groups). It is probable that this difference reflects the fact that this study involved black Americans at a predominantly black institution whereas the previous ones considered minority students at majority institutions. This conclusion would be in agreement with both the previous findings that traditional variables predicted performance of black students at predominantly black colleges reasonably well(5,6,7) and the observation that they predicted the performance of blacks at predominantly white institutions considerably less accurately than they predicted the performance of white students at those same institutions(9,10).

Finally, it should be noted that although the present study indicated that combinations of traditional variables had value in predicting success of blacks in a pre-health program, such variables should be used cautiously in admissions decisions. The limits on their use is illustrated by the fact that from 28.1 to 46.5 percent of the successful students in this study had their success predicted when the functions obtained in the discriminant analyses were used for classification. In view of the dire underrepresentation of blacks in the health fields, basing admission decisions on these equations would be unwise, since it would needlessly eliminate many who are needed and appear to be headed for success. It is likely that similar studies which include other, noncognitive factors would produce better results for such purposes.

2. Does predictive power for black males vary from that of black females?

Since the number of cases in some categories were relatively small, any conclusions regarding this question must be tentative in nature. However, the separate multiple discriminant analyses for males and females suggest that it is possible to distinguish successful from unsuccessful males as accurately as could be done for females. For both females and males, ACT Composite scores and high school grade point averages were the best two-variable combinations for predicting success. These findings were in agreement with the previous studies at XU which found that combinations of these two were the best two-variable predictors of grade in the first semesters of biology, chemistry, mathematics and physics. However, the relative differences in the importance of ACT Composite and high school grade point average in predicting success in pre-health, as well as the predictive power of Nelson-Denny Reading Total for males, suggested that accuracy of prediction might be increased by using a different predictive procedure for males from that used for females. This conclusion was similar to that found in studying entry-level physics although that study also included a relatively small sample of males. Additional study of the relationship between ability to predict performance/persistence and sex would be of value to those interested in correcting the underrepresentation of either minority groups or females in science-related fields.

3. What implications can be drawn from comparison of this study with past investigations?

Previous investigations have shown that traditional cognitive variables have value in predicting the academic performance of blacks at predominantly black institutions, but that they do not predict performance or persistence of blacks at majority institutions. This study showed that it was possible to predict performance/persistence for black students in pre-health at a predominantly black institution. The question of whether or not these measures would predict for black students in pre-health at majority institutions is open to question, but there is evidence to suggest that they do not(9,10). If so, the question of why not is of some importance, both to those interested in the interpretation of studies of this type, and to those concerned with the specific academic difficulties experienced by minorities.

On the basis of these studies, the authors propose that traditional variables would be expected to predict either performance or persistence as well for blacks as for whites *when all other factors are equal*. However, the best predictor for blacks may differ from the best predictors for majority students. Predictor studies, then, have value not just for prediction, but for determining the extent to which the needs of black students are being served. If the traditional variables do not predict grades or persistence of black students, this could indicate that a noncognitive factor, possibly a cultural one, is interfering with the academic process. In such cases, attempts to help blacks achieve academically should not focus solely on traditional tutoring and development of pre-requisite skills, but should place equal emphasis on developing support systems which overcome the interfering noncognitive factors. Research would be needed to identify the specific noncognitive factors which lead to the failure of traditional academic indicators to predict on individual campuses, so that support strategies could be tailored to local conditions.

Acknowledgement

This study was undertaken as one part of an assessment of Xavier's pre-health professions program made in order to better utilize funding provided by the Josiah Macy, Jr. Foundation and the Health Careers Opportunity Program (Division of Disadvantaged Assistance, Bureau of Health Professions, HRSA).

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